Wide-field atmospheric turbulence mitigation using short-exposure video sequences and machine learning

Work by
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Presented by
Spencer Bialek, PhD UVic
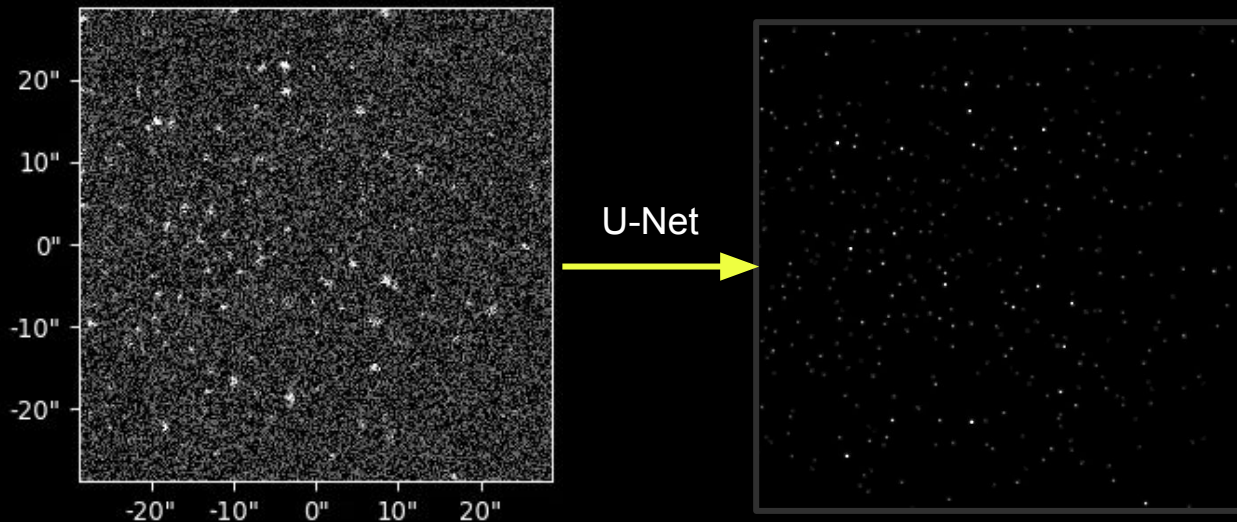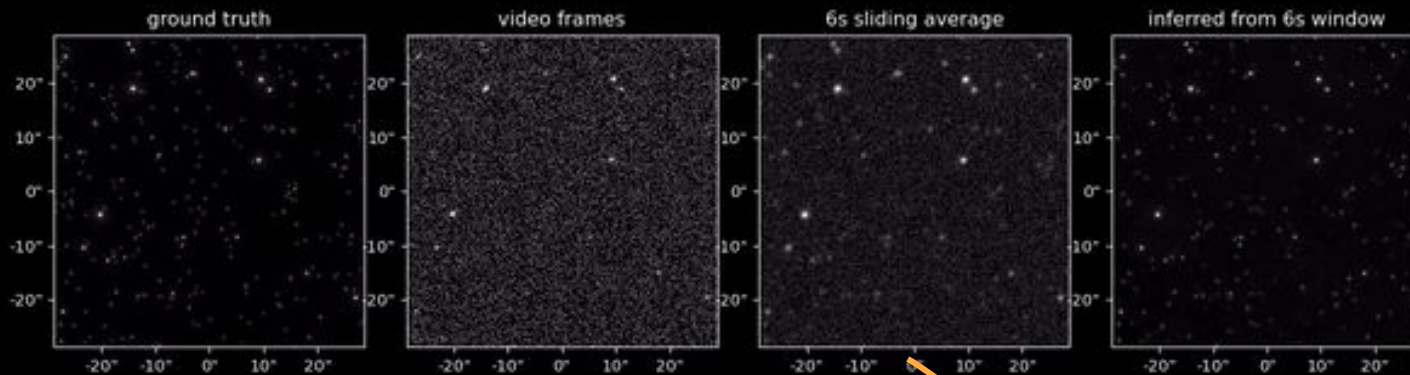Feb. 22, 2023

DanceCam

Simulate a video sequence of the turbulence!

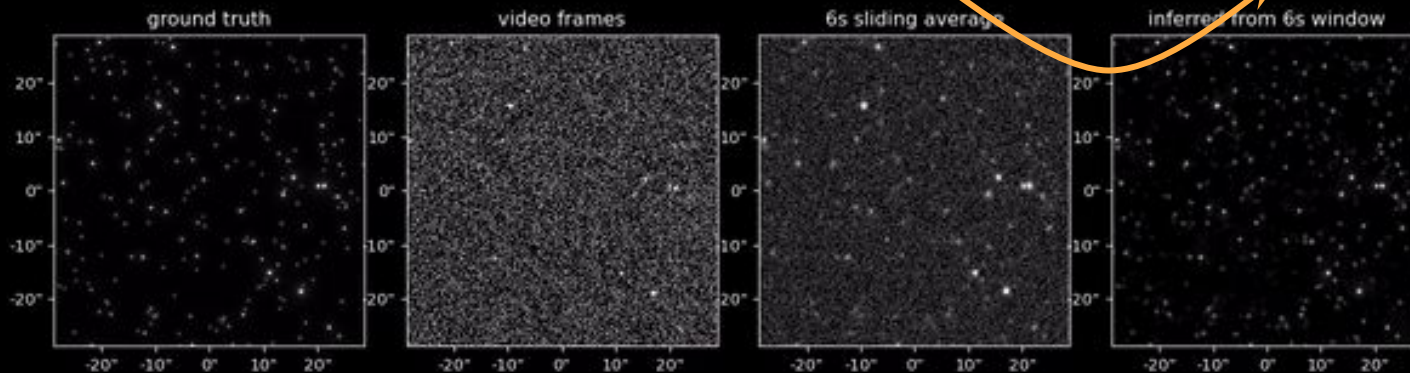And then predict the turbulence-free image from the sequence of short-exposure frames

U-Net

DanceCam - The Results (on **simulated** data)
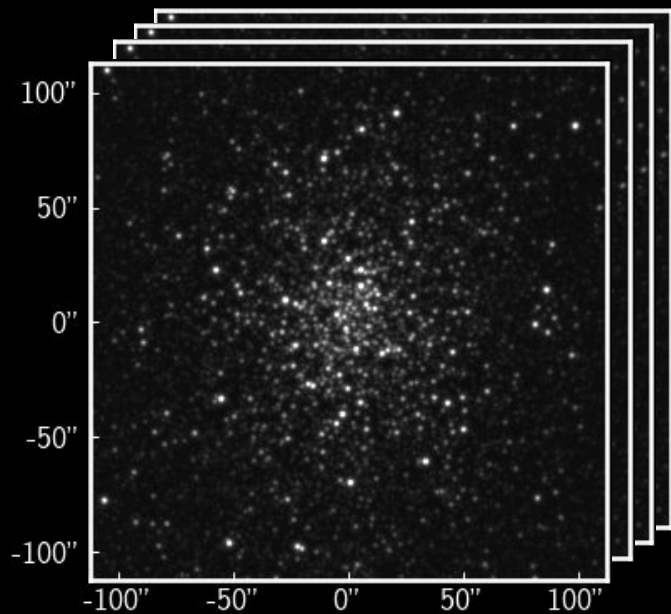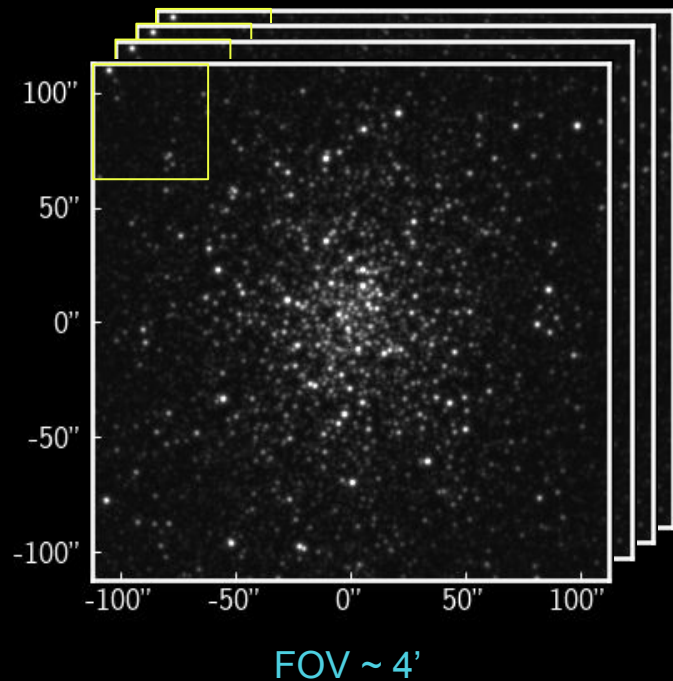

~2-6x better
IQ/resolution

DanceCam - Tiling inference for *arbitrarily wide* fields

FOV ~ 4'

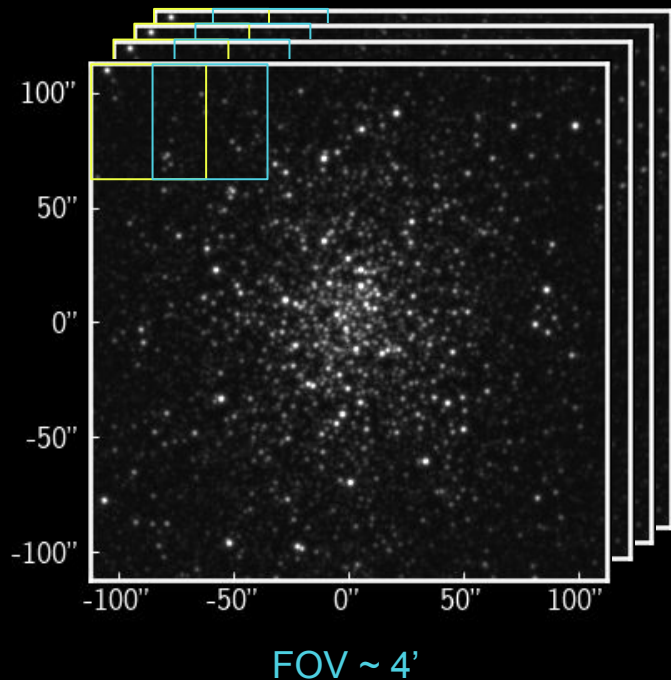# DanceCam - Tiling inference for *arbitrarily wide* fields

FOV ~ 4'

DanceCam - Tiling inference for *arbitrarily wide* fields
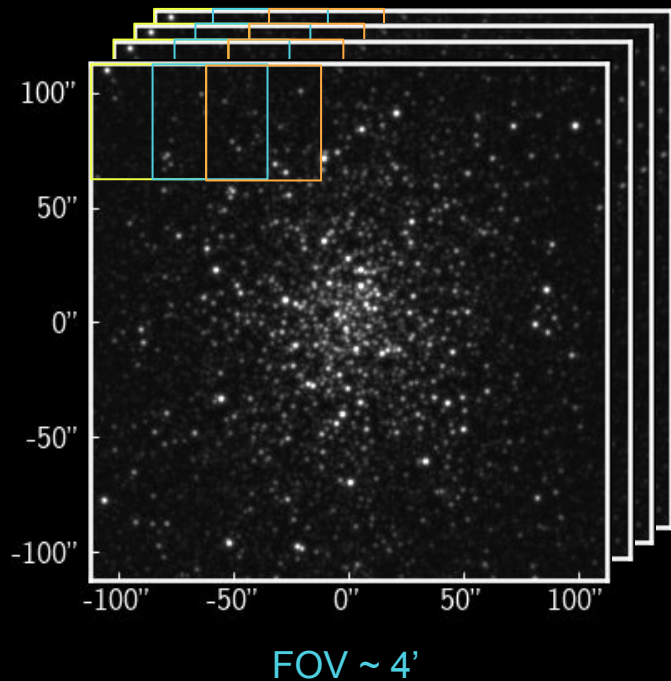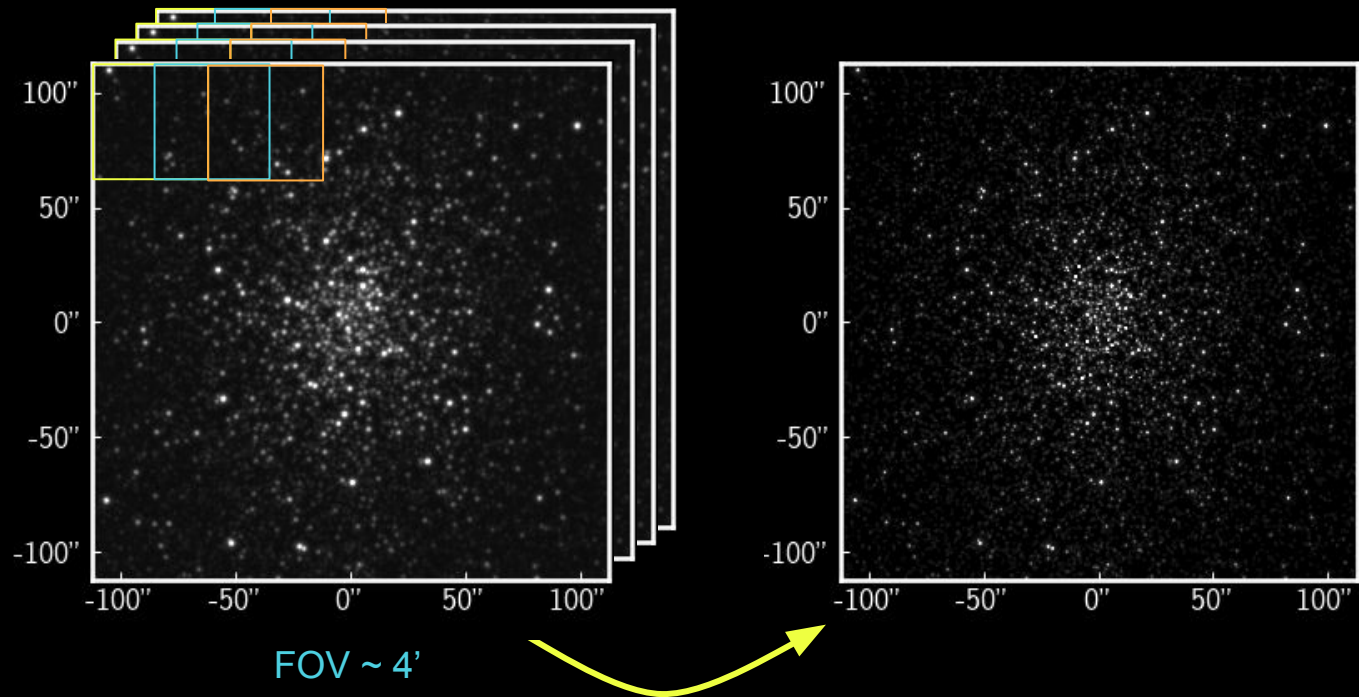

FOV ~ 4'

DanceCam - Tiling inference for *arbitrarily wide* fields

FOV ~ 4'

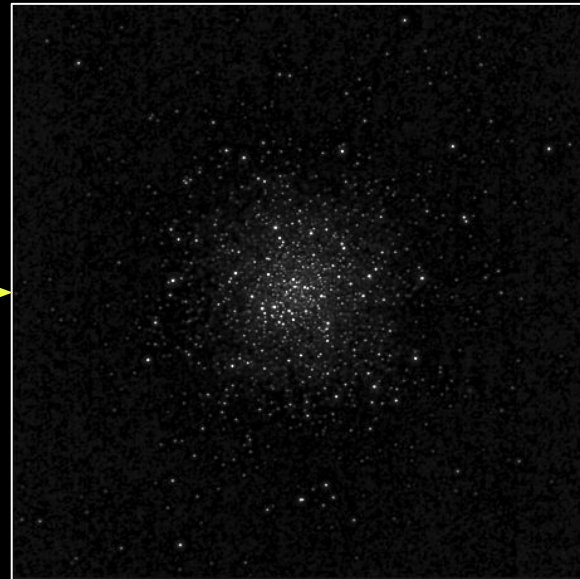# DanceCam - Tiling inference for *arbitrarily wide* fields

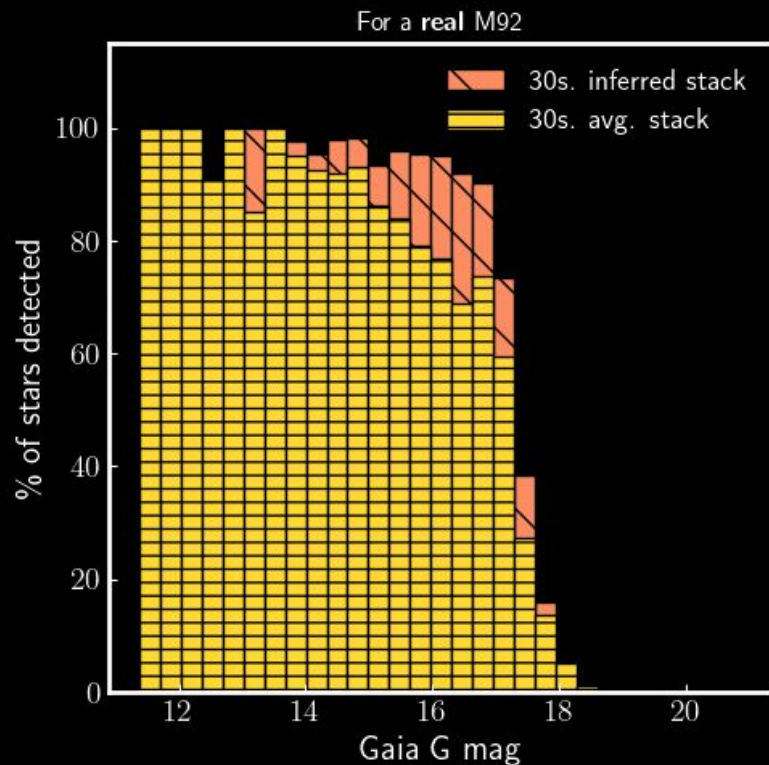FOV ~ 4'

DanceCam - Test case (real M92 data)
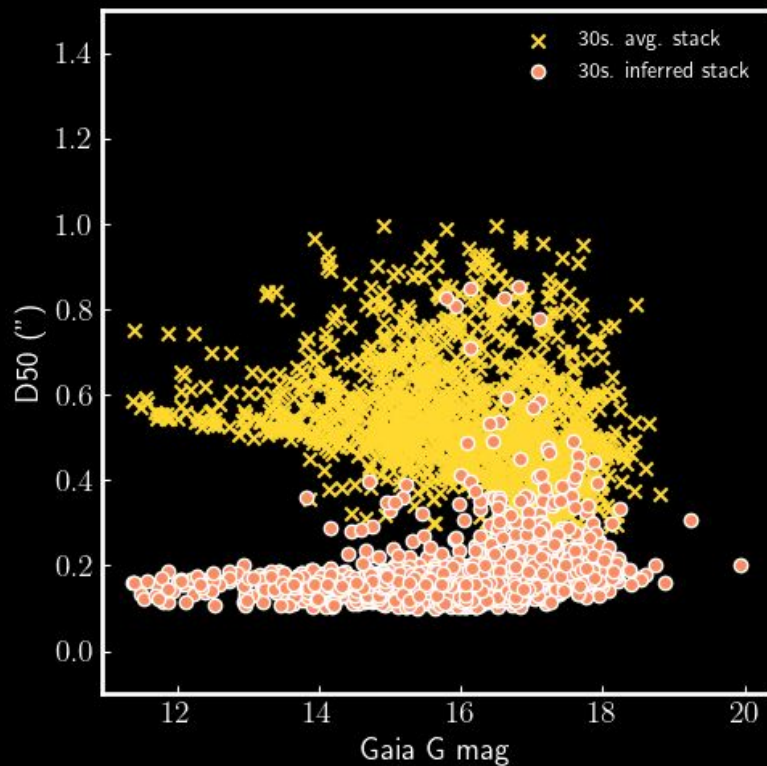

Simple averaged stack

Inferred stack

FOV ~ 4'

DanceCam - Test case (real M92 data)

For a **real** M92

~25% more stars detected

DanceCam - Test case (real M92 data)

2-4x better resolution

DanceCam - Limitations and Future Work

Limitations:

- hardware
- sim2real
- decreased performance on fainter sources

Plans to implement:

- polychromatism
- motion blurring and turbulence intermittency
- **extended sources** (planets, galaxies, moon, etc.)
- predicting the turbulence structure of the atmosphere
- changes to training technique

Thanks NTCO !